



Personalised and wearable systems for lifestyle management

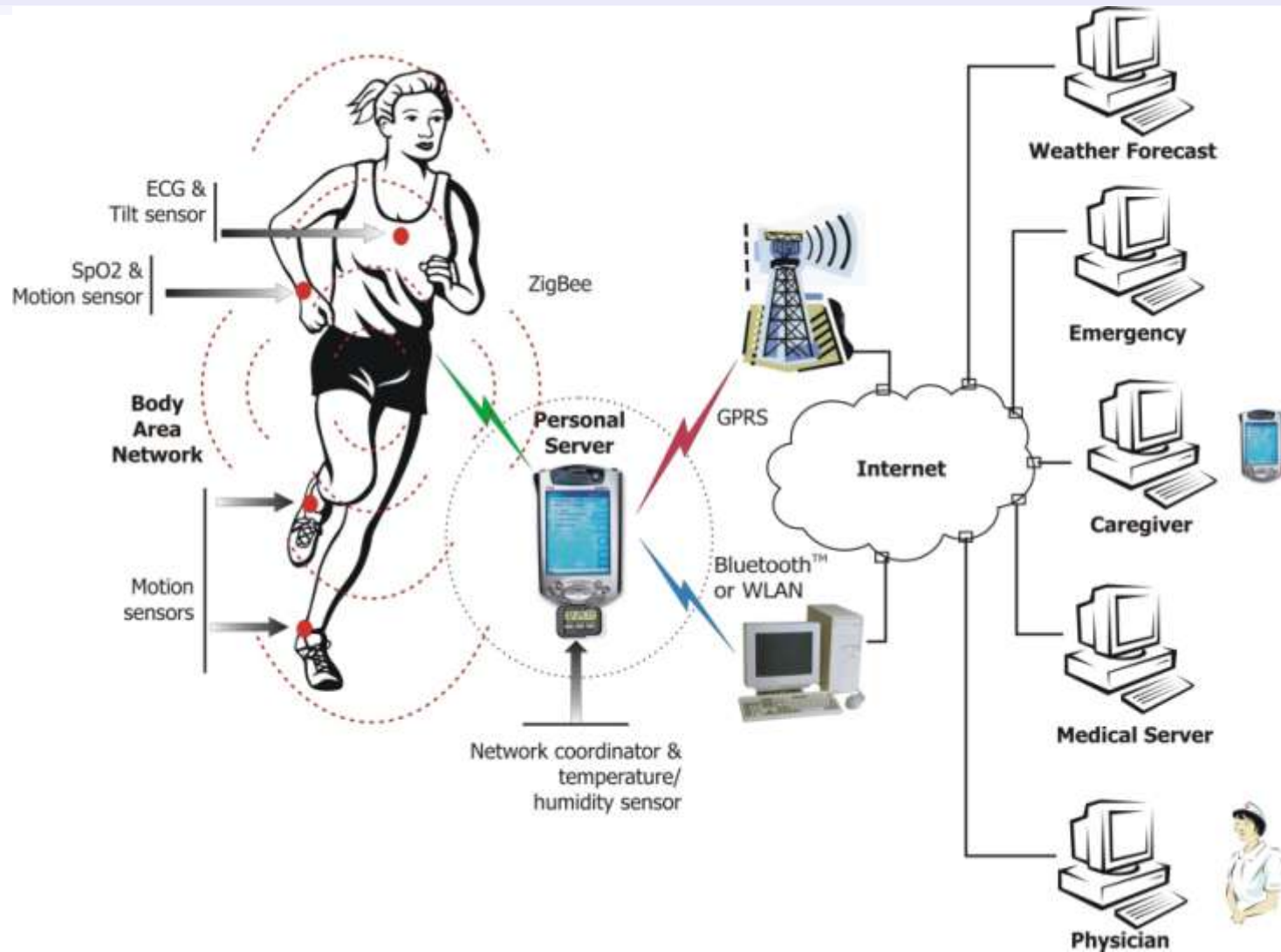
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Keywords

- ✓ **M-Health Mobile Health** integration of technologies of mobile computing and medical sensors with wireless communications in a system of sanitary assistance
- ✓ **WBAN Wireless Body Area Network** wireless communication between several miniaturized body sensor units and a single body central unit worn at the human body.
- ✓ **Pervasive Health monitoring systems** The notion of pervasive health monitoring presents us with a paradigm shift from the traditional event-driven model (i.e. go to doctor when sick) to one where we are continuously monitoring a person's "well-being" through the use of bio-sensors, smart-home technologies, and information networks.
- ✓ **Ubiquitous health monitoring systems** used anywhere without disrupting the everyday life of the patient.
- ✓ **Anywhere Anytime Anyway**

Ubiquitous Health Monitoring



Wearable concept



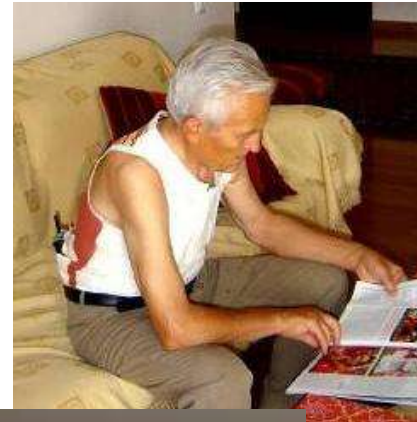
Wearable systems

State of the art

50 years ago



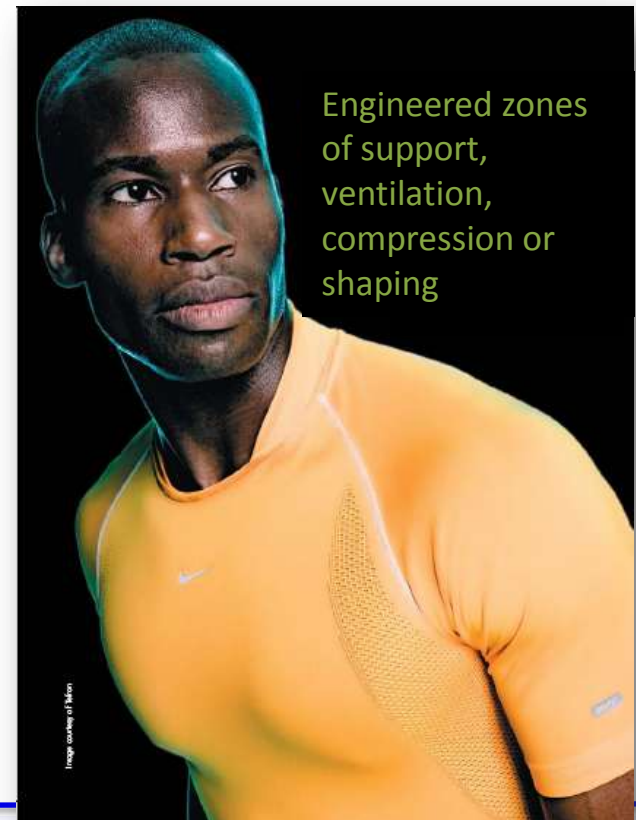
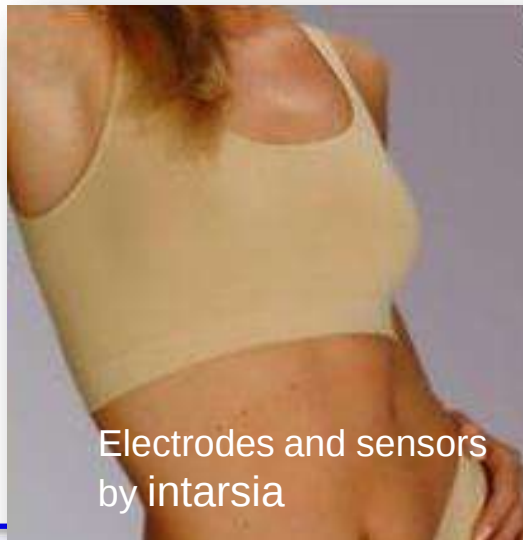
Today



Seamless technology

Seamless technology provides:

- Possibility to tune the mechanical proprieties of sensors
- Shaped zones by using intarsia technology and different elasticity
- Pocket knitted in the same production step
- Low production costs



Smart shirt



Yarns for sensors and electrodes

Material investigated:

Textile yarns with electrical properties:

- Metal yarns;
- Yarns containing conductive fibers like stainless steel mixed with natural or synthetic fibers
- Yarns containing electroconductive fibers
- Polymeric or carbon coated threads.

Advantages :

- ✓ *low cost,*
- possibility to realise*
redundant systems of sensors
on a single garment , by using
textile technology
- ✓ *wearability*



Bekinox® VS is a sliver of 100 % stainless steel fibres.



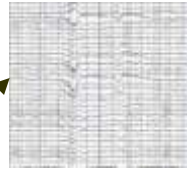
Wearable Systems

Overview BioSignals

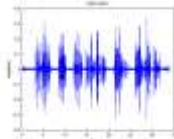
Eye-Gaze/Pupil



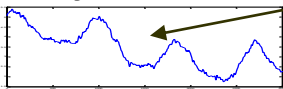
EEG



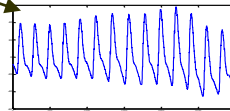
Speech



Respiration Activity



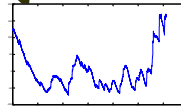
PPG



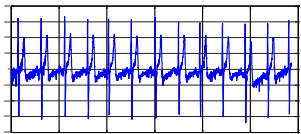
EMG



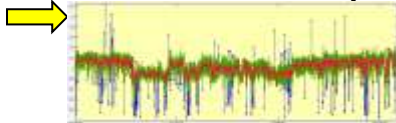
EDR



ECG



Heart rate Variability

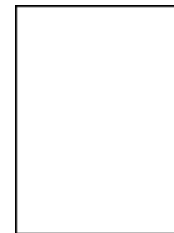


Signal Acquisition

Commercial hardware



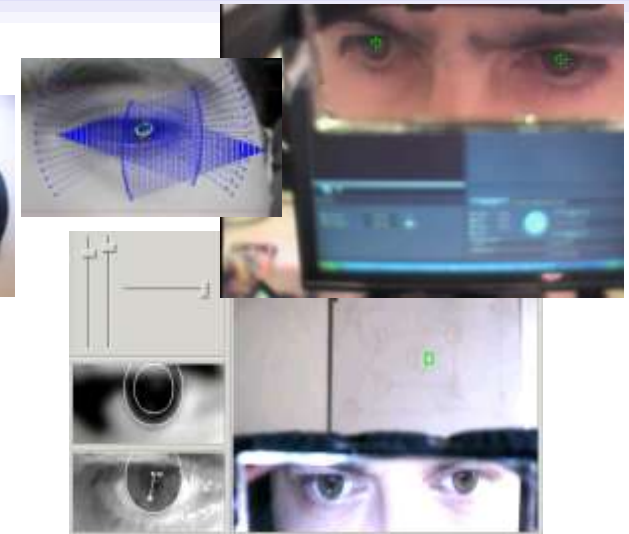
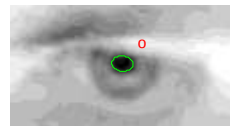
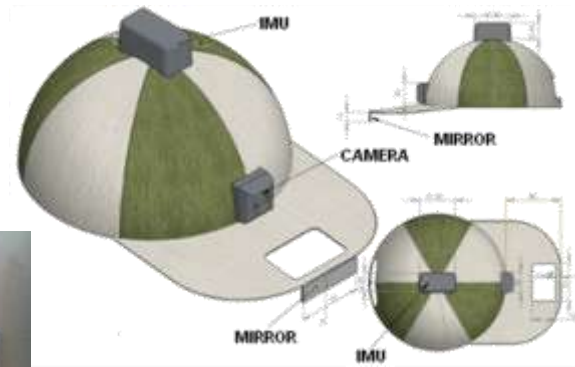
Research on new Sensors and Wearable Systems





Research on new Sensors and Wearable Systems

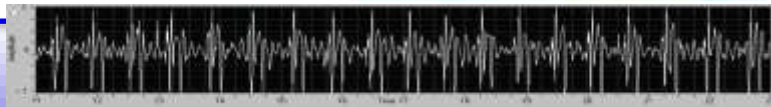
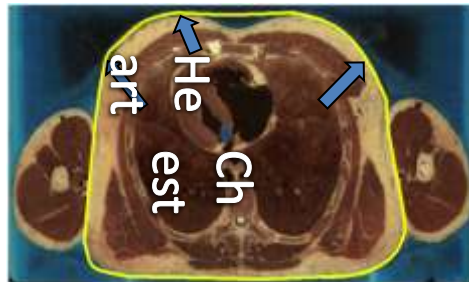
Eye-tracking and Pupil size variation



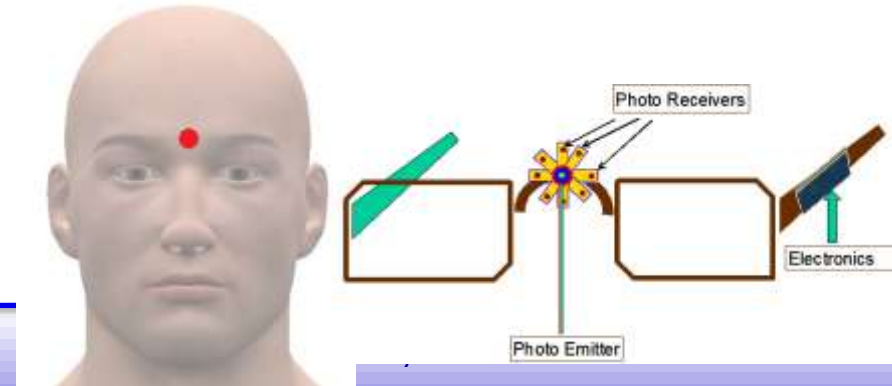
Textile-based glove for EDR



Piezoelectric-based Single sensor for Cardiac Sounds, Breath and Heart Beat



Smart-Glasses for Glabellar Pulse oximeter





Recent fields of interest

Emotions

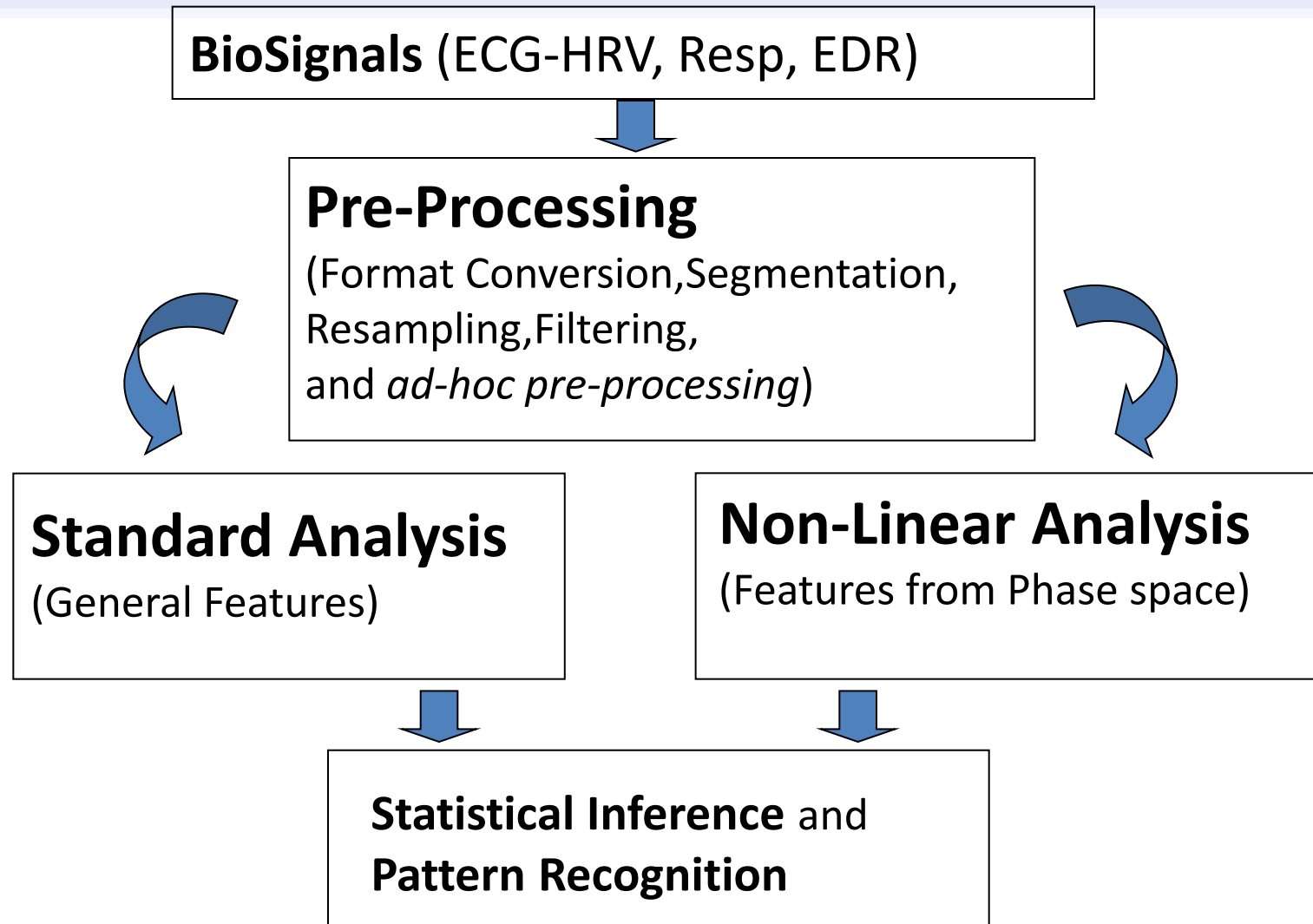
**Mood
disorders**

**Consciousness
disorders**

NEW

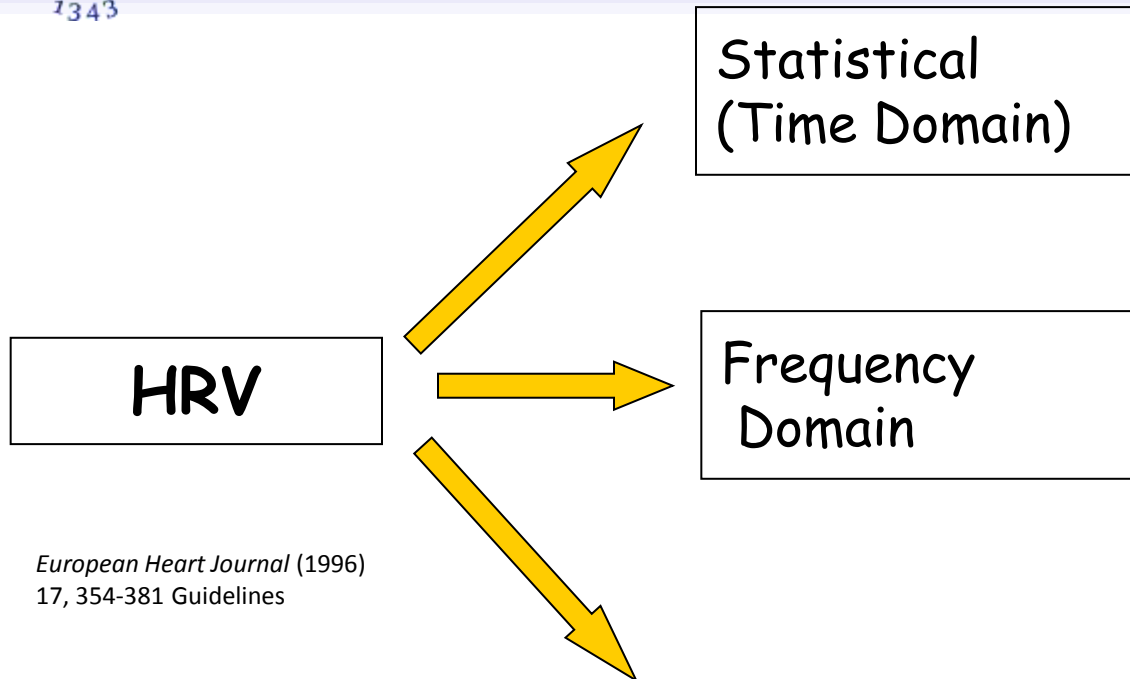
**Human-horse
interaction**

Methodology of Signal Processing

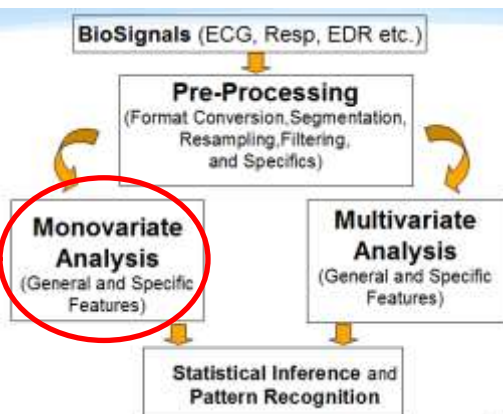




Example of HRV Feature Extraction



European Heart Journal (1996)
17, 354-381 Guidelines



Variable	Units
Mean RR*	(ms)
STD RR (SDNN)	(ms)
Mean HR*	(1/min)
STD HR	(1/min)
RMSSD	(ms)
NN50	(count)
pNN50	(%)
RR triangular index	
TINN	(ms)

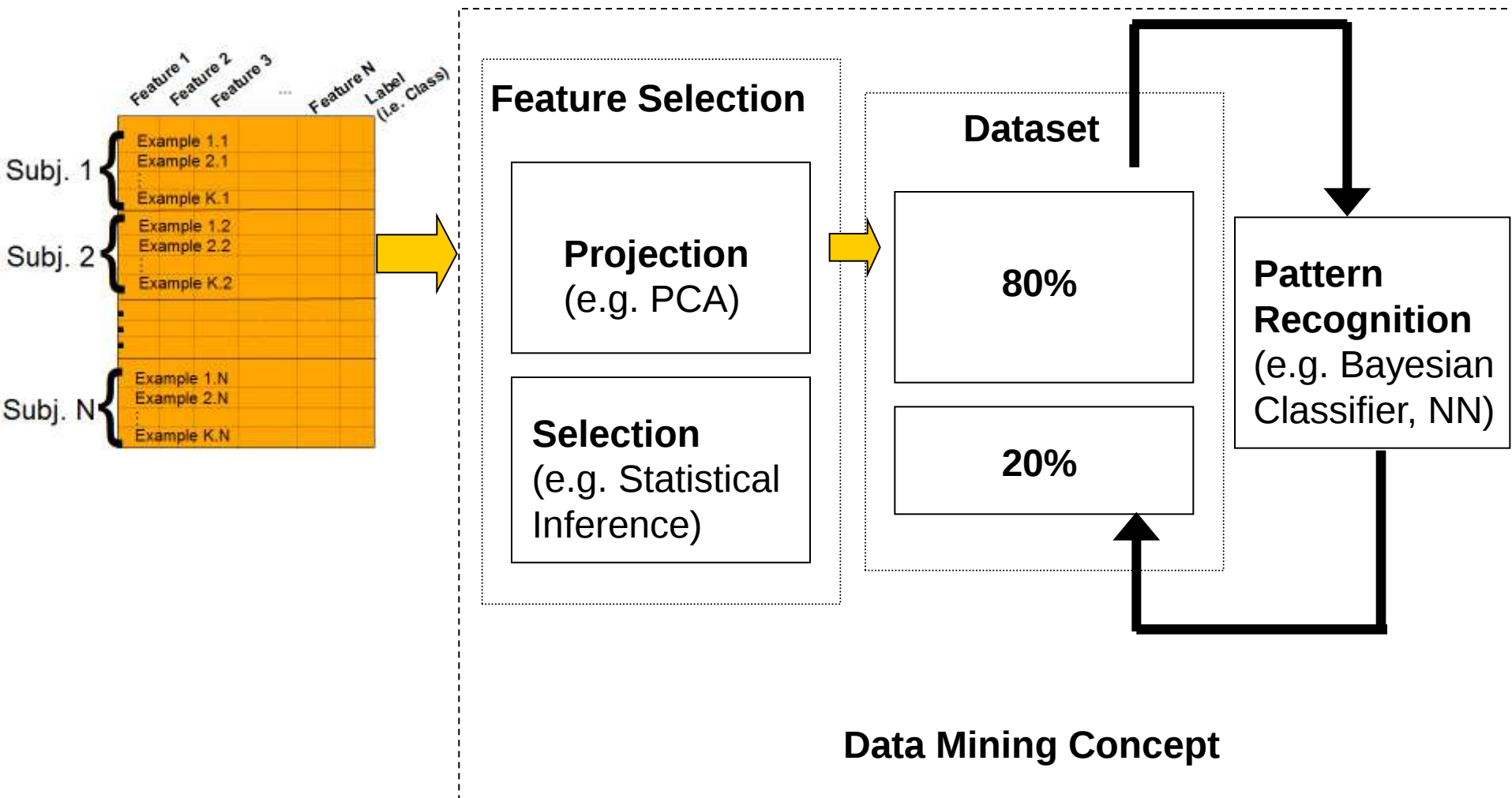
Frequency Band
VLF (0–0.04 Hz)
LF (0.04–0.15 Hz)
HF (0.15–0.4 Hz)
Total
LF/HF

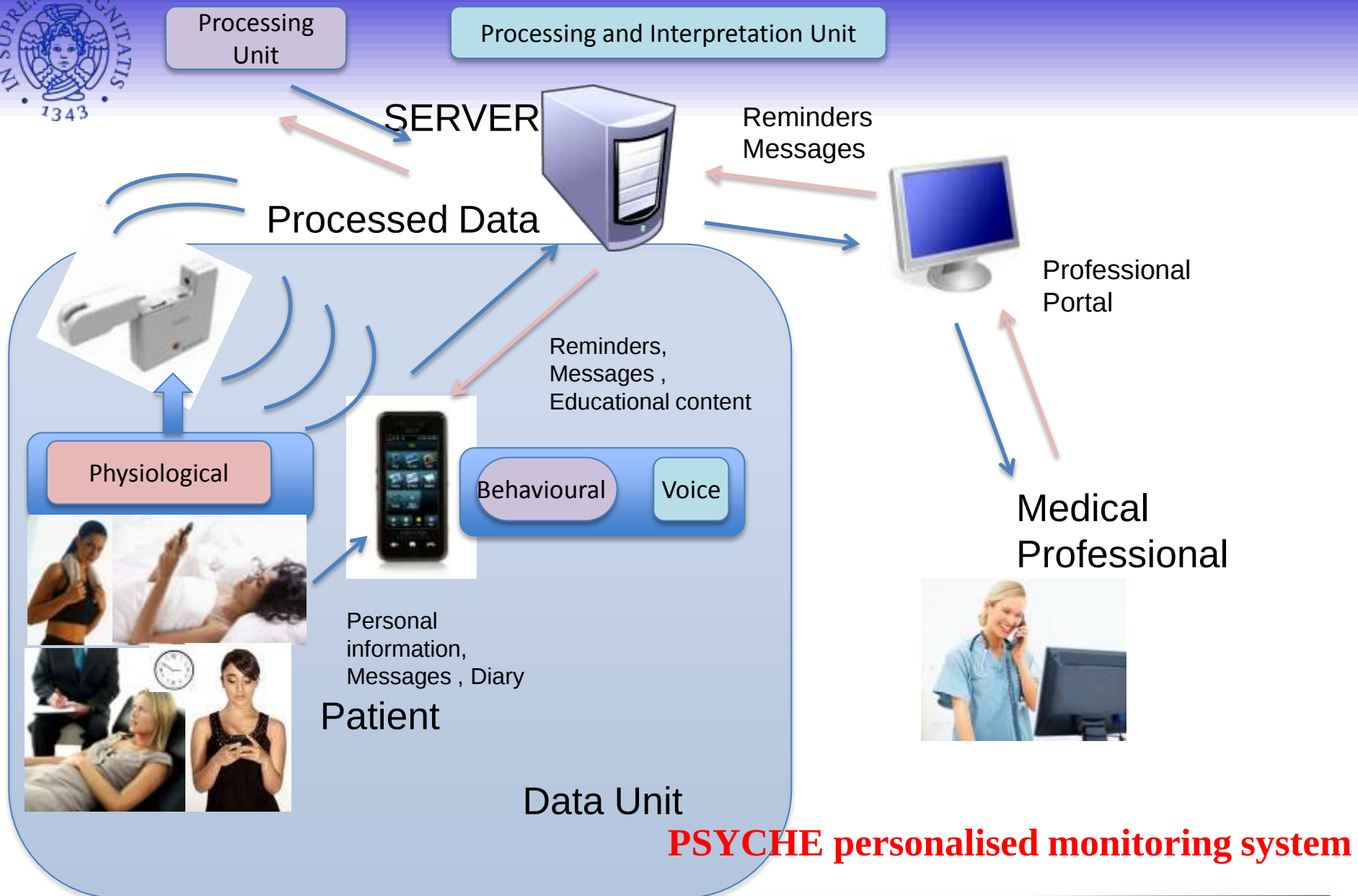
Variable	Units
Poincare plot	
SD1	(ms)
SD2	(ms)
Recurrence plot	
Mean line length (Lmean)	(beats)
Max line length (Lmax)	(beats)
Recurrence rate (REC)	(%)
Determinism (DET)	(%)
Shannon Entropy (ShanEn)	
Other	
Approximate entropy (ApEn)	
Sample entropy (SampEn)	
Detrended fluctuations (DFA): $\alpha 1$	
Detrended fluctuations (DFA): $\alpha 2$	
Correlation dimension (D2)	

*Results are calculated from the non-detrended selected RR series.



Overview Processing steps: Statistical inference and Pattern Recognition







Thank You



BioLab

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